IMPACT OF BIRD FAECAL MATTER MEDIATED NUTRIENTS ON WATER QUALITY IN ANAVILUNDAWA RESERVOIR AND HABITAT OCCUPANCY AND BEHAVIOUR OF SELECTED BIRD SPECIES IN TWO RESERVOIRS OF ANAVILUNDAWA RAMSAR SANCTUARY, SRI LANKA

THESIS SUBMITTED

FOR THE

DEGREE OF MASTER OF PHILOSOPHY

IN THE

UNIVERSITY OF KELANIYA, SRI LANKA

BY

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SRI LANKA.

FEBRUARY 2013

Abstract

Many of the seasonal water bodies in Sri Lanka harbour substantial numbers of aquatic birds. Local aggregation of water fowls during communal roosting and colonial breeding, results in substantial inputs of nutrients into aquatic systems. Most external (allochthonous) nutrient inputs and their concentrations are a resultant of human and other living organisms' activities in and around water bodies. The present study evaluates this lesser known allochthonus input into water sources, i.e. accumulation of bird faecal matter, behaviour of three aquatic bird species and density and species richness of true aquatic bird and aquatic associated bird species over the area. Accordingly, field investigations were carried out in Anavilundawa Ramsar sanctuary during 2007-2009, where the reservoir was divided into four strata; Inlet, Breeding Ground, Centre and Outlet. Surface and bottom water samples were analysed for NO_3^-, PO_4^{3-}, K^+, NH_4^+, alkalinity and DO. Mean reservoir depth, Secchi Disk Depth, temperature, turbidity and pH were also recorded. Surface water layer, the highest NO_3^- level was recorded in breeding ground of Asian openbill (0.55 mg/l) followed by reservoir centre. The highest PO_4^{3-} (0.99 mg/l), NH_4^+ (1.93 mg/l) and alkalinity (207.7 mg/l) levels were also recorded in breeding ground. The bottom layer; highest levels of NO_3^- (0.76 mg/l), PO_4^{3-} (0.83 mg/l), NH_4^+ (2.16 mg/l) and alkalinity (214.8 mg/l) were recorded in breeding ground. The lowest DO level was recorded in breeding ground; both surface (2.03 mg/l) and bottom (0.85 mg/l) water layers. The lowest pH was recorded in breeding ground for both surface (5.91) and bottom (5.94) water layers. The highest turbidity level was recorded in surface (19.9 NTU) inlet water layer and centre (30.9 NTU) bottom water layer. Canonical variate analysis of water quality parameters indicated the influence of ornithological eutrophication in water with four strata being significantly distinct for surface layer whilst, similarities in water quality in inlet and outlet for bottom layer. Results revealed mass waterfowl gathering leads to excessive nutrient loadings (guanotrophication); have severely altered the strophic conditions in some parts of Anavilundawa reservoir. Water surface in the Asian openbill breeding ground was noticeably covered by thick layer of aquatic floral mat consisting of Water hyacinth (*Eichhornia crassipes*), Salvinia (*Salvinia molesta*), Duckweed fern (*Azolla pinnata*) and Knotweed or Knotgrass (*Polygonum barbatum* and *Polygonum glabrum*).

To understand interactions between habitats and bird species; behaviours of three different waterfowl species i.e. Pheasant-tailed Jacana (*Hydrophasianus chirurgus*), Little Grebe (*Tachybaptus ruficollis*) and Purple Coot (*Porphyrio prophyrio*) in four different habitat types [open water, lily covered, Water hyacinth covered and grass covered] were studied. Studies were carried out in two reservoirs in Anavilundawa Ramsar sanctuary namely, Anavilundawa reservoir and Suruwila reservoir. A total of eleven behaviour patterns of the three bird species were recorded through focal sampling, using a spotting scope and an optical zooming video camera. Frequency of occurrence of the each behaviour pattern was calculated at 18-20 minutes observation periods. Results revealed that Purple Coots occupied only Water hyacinth covered habitats and all their behaviour patterns occurred in Water hyacinth covered habitats. Jacanas occupied grass covered habitats, lily covered habitats and open water habitats. There was no significant difference in the frequency occurrence of feeding, vigilance and preening/stretching behaviour in grass covered and lily covered habitats. However, vigilance and feeding mostly occurred in lily covered habitats whilst walking in grass covered habitats. Little Grebes were using only open water habitats and lily covered habitats. The main behaviour patterns performed by Little Grebes in open water habitats were swimming, diving and vigilance. Hiding, walking and breeding only occurred in lily covered habitats. When the feeding behaviour only considered, lily covered habitats and open water habitats were the most important for the Little Grebe, both lily covered habitats, grass covered and open water habitats for Jacana and Water hyacinth covered habitats for the Purple Coots. When breeding behaviour only considered, lily covered habitats was the most important habitat for the Little Grebe and Water hyacinth covered habitats for the Purple Coots. However, no breeding behaviour was observed for Jacana in any part of the two reservoirs during the study period. Accordingly, results indicated niche segregation of the three species in terms of their behaviour.

In Anavilundawa reservoir, the number of true aquatic bird species was higher (40.49 ± 1.251 birds ha^{-1}) than the number of aquatic associated bird species (3.40 ± 0.437 birds ha^{-1}), possibly due to the availability of food and shelter with suitable other necessities. Amongst true aquatic birds recorded in the study area, Asian openbill was the most abundant species (137.43 ± 7.246 birds ha^{-1}). In contrast to other surrounding reservoirs, Asian openbill only inhabits the Anavilundawa reservoir for nesting and breeding. Density and species richness of birds were the highest during rainy season

when migratory species also arrived. During the rainy season; the highest bird density was recorded in tree-covered habitats (11.72 ± 1.683 birds ha^{-1}) followed by shallow open water habitats (2.05 ± 0.724 birds ha^{-1}) and grass covered habitats (1.84 ± 0.579 birds ha^{-1}). The lowest bird density was recorded in deep open water habitats (0.40 ± 0.263 birds ha^{-1}). During dry season when the migratory species left the area and a few resident species were engaged in the nesting activities. During the dry season too, the highest bird density was recorded in tree covered habitats (1.57 ± 0.497 birds ha^{-1}) followed by grass covered habitats (0.99 ± 0.317 birds ha^{-1}) and shallow open water habitats (0.63 ± 0.374 birds ha^{-1}). Among the aquatic associated species, Red-wattled Lapwing was the most abundant species (2.05 ± 1.137 birds ha^{-1}). The result also showed that true aquatic birds have the highest species diversity i.e., Shannon's index (N_1 = 2.233), species richness i.e., Margalf's index (R_1 = 2.015), Menhinick's index (R_2 = 0.782) and species evenness i.e., (E = 0.899) which were much higher compared to aquatic associated bird.

Yet, mass waterfowl gathering altered the available native habitats both true aquatic bird and aquatic associated bird get the advantage from the wetland either in terms of density or in terms of diversity. For example, generalists like Purple Coot were adapted to invaded habitats for their existence over the years. Still, Little Grebe which is a habitat specialist was found in less abundance indicating the impacts of spread of invasive plants on habitat specialists. However, charismatic characteristics of high absorption rate and rapid growth of invasive flora manage to defuse effects of excessive nutrient loading to the reservoir. On the other hand, aggressive infestation dominates the reservoir ecosystem creating monocultures of exotic species, which may lead to loss of biodiversity. In addition being seasonal at the end of each dry period a large biomass of dead vegetation accumulate in the reservoir beds that could lead to gradual siltation. This process is unlikely to be reversed without habitat restoration. In terms of conservation and restoration of reservoir ecosystem, there is still much to learn about the roles that invasive flora and native fauna interrelationships.